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DEVICE TO TRANSPORT OBJECT TO BE PROCESSED
[Hishoritai no hanso sochi]

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[Claims] /*

[Claim 1] A device to transport an object to be processed equipped with an airtight container that has a removable lid on a front open area and houses an object to be processed inside said container, and a transport mechanism that takes out an object to be processed inside said airtight container in an isolation chamber from said airtight container and then delivers the object to a processing chamber,

said device to transport an object to be processed is also characterized by being provided with an isolation chamber in a room facing the open area of said airtight container that reduces the pressure differential between said room and airtight container, and a lid opening/closing mechanism that opens and closes the lid of said airtight container inside this isolation chamber.

[Claim 2] A device to transport an object to be processed as set forth in Claim 1 characterized by the ability to withdraw said isolation chamber from an open area of a lid opening/closing mechanism as well as from an open area of an airtight container while transporting an object to be processed.

[Claim 3] A device to transport an object to be processed equipped with an airtight container that has a removable lid on a front open area and houses an object to be processed inside said container, and a transport mechanism that takes out an object to be

*Claim and paragraph numbers correspond to those in the foreign text.

processed inside said airtight container in an isolation chamber from said airtight container and then delivers the object to a processing chamber,

said device to transport an object to be processed is also characterized by being provided with a lid opening/closing mechanism that opens and closes the lid of said airtight container in a room facing the open area of said airtight container and a covering member in this lid opening/closing mechanism that forms an isolation chamber and reduces the pressure differential between said room and airtight container.

[Claim 4] A device to transport an object to be processed as set forth in Claim 3 characterized by the ability to withdraw said covering member from an open area of a lid opening/closing mechanism as well as from an open area of an airtight container while transporting an object to be processed.

[Claim 5] A device to transport an object to be processed as set forth in Claim 1 or Claim 3 characterized by said isolation chamber being equipped with a pressure regulation means that matches the internal pressure with the pressure of an airtight container and a room.

[Claim 6] A device to transport an object to be processed as set forth in Claim 1 or Claim 3 characterized by said lid opening/closing mechanism having a lid lock member that can move forward and rearward opposite to the open area of an airtight container and said lid

opening/closing mechanism seals an open area of a lid by means of forward action of a lid lock member and opens an open area by means of rearward action.

[Claim 7] A device to transport an object to be processed as set forth in Claim 1 or Claim 3 characterized by said lid lock member being provided with a detachable engagement member on an engagement receiver of a lid that detaches a lid lock member and a lid by means of a relative attachment/detachment movement between a lid lock member and an airtight container.

[Claim 8] A device to transport an object to be processed as set forth in Claim 1 or Claim 3 characterized by said lid opening/closing mechanism having a lid lock member that can move forward and rearward opposite to the open area of an airtight container and said lid opening/closing mechanism seals an open area of a lid by means of forward action of a lid lock member and opens an open area by means of rearward action.

[Claim 9] A device to transport an object to be processed as set forth in Claim 1 or Claim 3 characterized by said lid lock member being provided with a detachable engagement member on an engagement receiver of a lid that detaches a lid lock member and a lid by means of a relative attachment/detachment movement between a lid lock member and an airtight container.

[Detailed Description of the Invention]

[0001] [Field of the Invention]

This present invention relates to a device to transport an object to be processed in a multi-chamber processing system equipped with a plurality of vacuum processing chambers which process mainly objects to be processed such as semiconductor wafers or LCD substrates.

[0002] [Description of the Prior Art]

In recent years, various devices have been considered for semiconductor manufacturing processes following the miniaturization and higher integration of semiconductor devices. For example, multi-chamber processing systems, referred to as cluster tools, have been developed equipped with a plurality of vacuum processing chambers encircling the system to allow each type of process of the vacuum processing system of a semiconductor wafer to be easily reorganized and updated and as well as shorten the processes by means of consistent processing.

[0003] This type of conventional multi-chamber processing system is known to be equipped with a number of vacuum processing chambers (process chambers) required (assuming, for example, a minimum of three pieces or a maximum of six) for the various types of semiconductor manufacturing processes along with a transport system that receives and transports an object to be processed into each vacuum processing chamber being equipped with one or two loader chambers, a polygon shaped transfer chamber (transfer chamber) that has a plurality of connection ports on the peripheral wall linked

airtight through gate valves with each vacuum processing chamber and loader chamber arranged encircling the system, and a transport arm (transfer robot) that can be rotated as well as extended and retracted and is installed in a transfer chamber.

[0004] This type of multi-chamber processing system has an FOUP that stores, for example, semiconductor wafers (hereinafter, referred to as simply wafers) as an object to be processed or namely, has an open area on the front and then carries the wafers to the inside of the loader chamber using an external transport device in airtight container units (hereinafter, referred to as simply airtight container) which have a removable lid in this open area. Thereupon, after replacing the interior of the loader chamber with a vacuum or an inert gas and isolating it from the outside, the gate valve on the side of the transfer chamber of the loader chamber opens, the transport arm takes the wafers one at a time from the airtight containers inside this loader chamber in a transfer chamber and sequentially delivers them to the inside of the required necessary vacuum processing chamber. Thereafter, predetermined processing such as film formation or etching is performed and then the processed wafer is removed by a transport arm inside a transfer chamber and returned to the airtight container inside the loader chamber.

[0005] Since the loader chamber and transfer chamber (transport systems) are used in common with a plurality of vacuum processing chambers arranged encircling the system in this type of multi-chamber

processing system, there are tremendous benefits such as a simpler structure, reduced installation space and improved transport efficiency, and lower costs due to local cleaning compared to a conventional processing unit provided with a separate transport system for each of the vacuum processing chambers.

[0006] [Problems to be Solved by the Invention]

In contrast to the high atmospheric pressure in an external transport device that transports the airtight container wherein the wafers are stored, the loader chambers are set to a pressure slightly higher than the atmospheric pressure and both of the chambers are divided by a partition wall. A linkage port is provided on one part of the partition wall and a lid opening/closing mechanism that opens and closes the lid of an airtight container is provided inside a loader chamber opposite to a linkage port.

[0007] And since a lid opening/closing mechanism opens the lid of an airtight container while transporting a wafer and the wafer is held inside the airtight container by the transport arm extending from the loader chamber and transported to the loader chamber, the wafer is transported at atmospheric pressure. However, it is not known whether the pressure inside the airtight container is set to a pressure higher than atmospheric pressure or set to a pressure lower. Therefore, there is a problem in which when the lid is opened while the airtight container is at a lower atmospheric pressure, the surrounding air enters into the airtight container and causes an

uneven air flow resulting in dust rising up and adhering to the wafer thereby causing the wafer to be a defective product. Conversely, there is a problem in which when the lid is opened while the airtight container is at a higher atmospheric pressure, the air inside the airtight container will be discharged to the outside and the uneven air flow inside the airtight container at that moment will cause the wafer to slide on the shelf inside the airtight container scratching the wafer and thereby causing the wafer to be a defective product in the same manner.

[0008] The objective of the present invention is to take these issues into consideration and provide a device to transport an object to be processed that can reduce the pressure differential between an airtight container and a surrounding room, prevent uneven air flow when the lid of an airtight container is opened, and also prevent dust from adhering to or scratches on a the wafer that is an object to be processed.

[0009] [Means for Solving the Problems]

In order to achieve these objectives, Claim 1 of the present invention is a device to transport an object to be processed equipped with an airtight container that has a removable lid on a front open area and houses an object to be processed inside the container and a transport mechanism that takes out an object to be processed inside the airtight container in an isolation chamber from the airtight container and then delivers the object to a processing chamber. This

device to transport an object to be processed is also characterized by being provided with an isolation chamber in a room facing the open area of the airtight container that reduces the pressure differential between the room and the airtight container and a lid opening/closing mechanism that opens and closes the lid of the airtight container inside this isolation chamber.

[0010] Claim 2 is characterized by the ability to withdraw the isolation chamber from an open area of a lid opening/closing mechanism as well as from an open area of an airtight container while transporting an object to be processed.

[0011] Claim 3 is characterized by a device to transport an object to be processed equipped with an airtight container that has a removable lid on a front open area and houses an object to be processed inside the container and a transport mechanism that takes out an object to be processed inside the airtight container in an isolation chamber from the airtight container and then delivers the object to a processing chamber. This device to transport an object to be processed is also characterized by being provided with a lid opening/closing mechanism that opens and closes the lid of the airtight container in a room facing the open area of the airtight container and a covering member in this lid opening/closing mechanism that forms an isolation chamber and reduces the pressure differential between the room and the airtight container.

[0012] Claim 4 is characterized by the ability to withdraw the covering member from an open area of a lid opening/closing mechanism as well as from an open area of an airtight container while transporting an object to be processed.

[0013] Claim 5 is characterized by the isolation chamber being equipped with a pressure regulation means that matches the internal pressure with the pressure of an airtight container and a room.

[0014] Claim 6 is characterized by the lid opening/closing mechanism of Claim 1 or Claim 3 having a lid lock member that can move forward and rearward opposite to the open area of an airtight container and the lid opening/closing mechanism sealing an open area of a lid by means of forward action of a lid lock member and opening an open area by means of rearward action.

[0015] Claim 7 is characterized by the lid lock member of Claim 1 or Claim 3 being provided with a detachable engagement member on an engagement receiver of a lid that detaches a lid lock member and a lid by means of a relative attachment/detachment movement between a lid lock member and an airtight container.

[0016] Claim 8 is characterized by the lid opening/closing mechanism of Claim 1 or Claim 3 having a lid lock member that can move forward and rearward opposite to the open area of an airtight container and the lid opening/closing mechanism sealing an open area of a lid by means of forward action of a lid lock member and opening an and open area by means of rearward action.

[0017] Claim 9 is characterized by the lid lock member of Claim 1 or Claim 3 being provided with a detachable engagement member on an engagement receiver of a lid that detaches a lid lock member and a lid by means of a relative attachment/detachment movement between a lid lock member and an airtight container.

[0018] According to this composition, by means of a lid opening/closing mechanism opening a lid of an airtight container after matching the internal pressure of an isolation chamber with the internal pressure of an airtight container, it is possible to eliminate uneven air flow inside the airtight container when an open area of an airtight container is opened and prevent dust from entering into an airtight container.

[0019] [Embodiment of the Invention]

In the following, an embodiment of the present invention will be described based on the drawings.

[0020] Figure 1 to Figure 7 show a first embodiment. Figure 1 is a horizontal cross-sectional view of a transport device in a multi-chamber processing system wherein three vacuum processing chambers are arranged encircling the system, Figure 2 is a side view of Figure 1, Figure 3 is a front view of a lid opening/closing mechanism, Figure 4 and Figure 5 are vertical cross-sectional side views of this mechanism, Figure 6 is an expanded front view of Figure 3, and Figure 7 is a descriptive operation view.

[0021] Figure 1 and Figure 2 show a multi-chamber processing system and a transport device with three vacuum processing chambers 1a, 1b, and 1c encircling the system which process the wafer W as an object to be processed. These vacuum processing chambers 1a, 1b, and 1c are airtight cube-shaped processing containers referred to as process chambers and are each loaded onto a stand 2 at a predetermined height.

[0022] From among these three chambers, the two vacuum processing chambers 1a, 1b are equipped with processing functions required for a wafer W. Examples of selected processing functions include sputtering, CVD, etching, ashing, oxidation, or diffusion. The one remaining vacuum processing chamber 1c is a reserve vacuum processing chamber that performs preceding and subsequent processing such as heating and cooling of the wafer W. Although not illustrated, a vacuum suction mechanism, a process gas injection mechanism, and a heating/cooling mechanism are equipped for the processing objectives.

[0023] Normally, in this type of multi-chamber processing system, a pattern equipped with the three vacuum processing chambers 1a, 1b, and 1c is assumed to be a minimum unit as the number of encircled vacuum processing chambers. The transport device used for a multi-chamber processing systems with this minimum pattern is provided with a polygon shaped load lock chamber 3 connected to each of the three vacuum processing chambers 1a, 1b, and 1c which are arranged in a three-sided encircled state, two loader chambers 4

connected to the front end of this load lock chamber 3, a transport arm 5 that can rotate and be extended and retracted and loads the wafer W from the inside of the loader chamber 4 in the load lock chamber 3 and then delivers it into the vacuum processing chambers 1a, 1b and 1c as well as removes the processed wafer W inside these vacuum processing chambers and returns it to inside of the loader chamber 4, a transfer chamber 6 linked to the two loader chambers 4, and a transport arm 7 that functions as a transport mechanism provided inside the transfer chamber 6.

[0024] In addition, 8 is an alignment mechanism that removes the wafer W from the transport arm 7 and positions it once. A bench 10 is also provided the outside of the transfer chamber 6 whereon the airtight container 11 (described later) is loaded through a stand 9.

[0025] The bench 10 whereon the transfer chamber 6 and the airtight container 11 are loaded are separated by a partition wall 12, as shown in Figure 3 to Figure 5 and the bench 10 whereon the airtight container 11 is loaded is at atmospheric pressure. The transfer chamber 6 is set to a pressure slightly higher than the atmospheric pressure and a pressure differential exists between both of them. A rectangular-shaped linkage port 13 that links both of these is provided in the partition wall 12. The airtight container 11 is opposite to the linkage port 13 and the bench 10 is moved forward and rearward by a cylinder or a motor (not shown in the figure).

[0026] The airtight container 11 has a FOUP, or namely, an open area 14 on the front surface. A plurality of wafers W are internally stored in the multistage format in a dust-free airtight cassette that has a removable lid 15 on this open area 14. A keyhole 16 that functions as an engagement receiver is provided at two locations on the front surface of the lid 15. An N_2 gas is injected inside the airtight container 11 to prevent oxidation for air depending on the condition of the wafer W or the internal pressure is set.

[0027] In addition, an isolation unit 18 is provided inside the transfer chamber 6 opposite to the linkage port 13. Along with sealing this linkage port, the isolation unit 18 forms an internal isolation chamber. This isolation unit 18 is formed from a front wall 18a and a peripheral wall 18b provided on the periphery of this front wall 18a and is comprised with a packing 8c attached to the open area edge of the peripheral wall 18b opposite to the open area edge of the linkage port 13 at a size that allows the linkage port 13 to be sealed.

[0028] Even further, a vertically long box 19 is provided at a position on the side of the transfer chamber 6 underneath the linkage port 13 and a linear guide 20 is provided in the upward/downward direction inside this vertically long box 19. An elevator bench 22 that can freely travel upward and downward using a Z-axis air cylinder 21 is provided on this linear guide 20. A movable bench 24 that can freely move forward and rearward with respect to the

partition wall 12 via a roller 23 is provided on the upper part of this elevator bench 22 and the isolation unit 18 is loaded onto this movable bench 24.

[0029] A cam plate 26 that has a cam groove 25 is attached to the movable bench 24 and a cam roller 28 that can freely move forward and rearward using an X-axis cylinder 27 secured to the movable bench 24 is engaged with the cam groove 25. If the cam roller 28 moves forward using the X-axis cylinder 27, the isolation unit 18 will move rearward away from the partition wall 12 along with the movable bench 24. If the cam roller 28 move rearward, the isolation unit 18 will move forward towards the partition wall 12 along with the movable bench 24 and the packing 18c will make contact with the partition wall 12 thereby sealing the isolation chamber 17.

[0030] In addition, a lid opening/closing mechanism 30 is provided on the elevator bench 22. In other words, a guide rail 31 is provided in a direction perpendicular to the partition wall 12 on the upper part of the elevator bench 22 and a support member 32 is supported on this guide rail 31 to be freely movable. A rectangular-shaped lid lock member 33 that can seal the linkage port 13 is attached to the support member 32. A latch 34 that functions as an engagement member, is provided on the front surface of this lid lock member 33 corresponding to the keyhole 16 of the lid 15. This latch 34 is rotated by means of a latch drive mechanism 35 provided on the back surface of the lid lock member 33.

[0031] An air cylinder 36 used for opening/closing a lid is supported on the elevator bench 22 so it can freely rotate. This air cylinder 36 is connected to the support member 32 through a flexible link mechanism 37. The lid lock member 33 moves forward and rearward with respect to the linkage port 13 through the support member 32 by means of the flexible motion of the flexible link mechanism 37 that is activated by the air cylinder 36.

[0032] A purge port 38 and an exhaust port 39, which function as a pressure regulation means, are provided at the lower part of the isolation unit 18 and allow the pressure inside the isolation chamber 17 to be adjusted. A labyrinth seal 40 is also provided in the support member 24 to prevent the pressure from changing while the isolation unit 18 is moving.

[0033] Next, the operation of the first embodiment will be described.

[0034] As shown in Figure 7 (a), the airtight container 11 loaded on the bench 10 is located at a position opposite to the linkage port 13 of the partition wall 12 and as shown in Figure 7 (b), the bench 10 moves forward and docks with this. The open area 14 of the airtight container 11 is opposite to the linkage port 13 and the lid 15 links to the lid locking mechanism 33 of the lid opening/closing mechanism 30 while the latch 34 engages into the keyhole 16. Thereupon, when the latch drive mechanism 35 is driven and the latch 34 rotates approximately 90°, the latch 34 will engage

with the keyhole 16, and the lid 15 and lid lock member 33 will be linked. At this point, the primary isolation chamber 18 is attached to the partition wall 12 and the internal pressure of the isolation chamber 17 is matched to the pressure inside the airtight container 11 by means of a purge or an exhaust from the purge port 38 and the exhaust port 39.

[0035] Next, when the air cylinder 36 is driven and the flexible link mechanism 37 is rotated while the pressure of the isolation chamber 17 and the airtight container 11 are almost equal, the support member 32 supported on the guide rail 31 will move rearward away from the partition wall 12 and, as shown in Figure 7 (c), the lid 15 that is linked to the lid lock member 33 is drawn into the inside of the isolation chamber 17 and the open area 14 of the airtight container 11 is opened. Since there is almost no pressure differential inside the airtight container 11 and in the isolation chamber 17 at this time, there is no uneven air flow inside the airtight container 11 eliminating any concern that dust will enter into the inside of the airtight container 11 as well as any concern that the wafer W will move and be scratched. Next, a purge or an exhaust from the purge port 38 and the exhaust port 39 is implemented so as to make the pressure of the isolation chamber 17 almost equal to the pressure of the transfer chamber 6.

[0036] When the pressure of the isolation chamber 17 and the transfer chamber 6 are almost equal and the X-axis cylinder 27

operates moving the cam roller 28 forward, the isolation unit 18 will move rearward away from the partition wall 12 via the movable bench 24 due to the inclination of the cam groove 25 engaging with the cam roller 38. And as shown in Figure 7 (d), this allows a gap g to exist between the peripheral wall 18b of the isolation unit 18 and the partition wall 12.

[0037] Next, when the Z-axis cylinder 21 is driven and the cylinder rod 21a is drawn in, the elevator bench 22 is guided on the linear guide 20 and lowered and, as shown in Figure 7 (e), the entire isolation unit 17 and lid opening/closing mechanism 30 loaded on elevator bench 22 are stored inside the vertically long box 19 and the isolation unit 17 and lid opening/closing mechanism 30 are withdrawn from the linkage port 13.

[0038] Next, the transport arm 7 provided inside the transfer chamber 6 is extended, the wafer W inside the airtight container 11 is grasped from the linkage port 13, the wafer W is transported to the inside of the transfer chamber 6 and then delivered to a multi-chamber processing system through a predetermined process. When the processing of all the wafers W inside the airtight container 11 is complete, the open area 14 of the airtight container 11 is sealed by the lid 15 and the operation to close the lid 15 will be performed as described above but in the reverse order.

[0039] Although the isolation unit 18 and the lid opening/closing mechanism 30 are comprised so as to withdraw from the

linkage port 13 in the first embodiment, they can also withdraw in the horizontal direction or upward.

[0040] Figure 8 shows a second embodiment. Compositional elements identical to the first embodiment use the same symbols but the description and drawings are omitted.

[0041] A rack-shaped isolation unit 50 is provided opposite to the open area edge of a linkage port 13 inside a transfer chamber 6 and a packing 51 is provided on the side of the partition wall 12 of this isolation unit 50 to seal the partition wall 12. The space between the outer periphery of this isolation unit 50 and the outer periphery of a lid lock member 33 of a lid opening/closing mechanism 30 are linked by a rectangular cylindrical bellows 52 that functions as a covering member and an isolation chamber 17 is formed inside. Therefore, the isolation unit 50 is attached and detached to the lid lock member 33 by means of the elasticity of the bellows 52.

[0042] Next, the operation of the second embodiment will be described.

[0043] As shown in Fig, 8 (a), the airtight container 11 loaded on the bench 10 is located at a position opposite to the linkage port 13 of the partition wall 12 and as shown in Figure 8 (b), the bench 10 moves forward and docks with this. The open area 14 of the airtight container 11 is opposite to the linkage port 13 and the lid 15 links to the lid locking mechanism 33 of the lid opening/closing mechanism 30 while the latch 34 engages into the keyhole 16.

Thereupon, when the latch drive mechanism 35 is driven and the latch 34 rotates approximately 90°, the latch 34 will engage with the keyhole 16 and the lid 15 and lid lock member 33 will be linked. At this point, the isolation unit 50 is attached to the partition wall 12 and the internal pressure of the isolation chamber 17 is matched to the pressure inside the airtight container 11 by means of a purge or an exhaust from the purge port 38 and the exhaust port 39.

[0044] Next, when the air cylinder 36 is driven and the flexible link mechanism 37 is rotated while the pressure of the isolation chamber 17 and the airtight container 11 are almost equal, the support member 32 supported on the guide rail 31 will move rearward away from the partition wall 12 and, as shown in Figure 8 (c), the lid 15 that is linked to the lid lock member 33 is separated from the open area 14 of the airtight container 11 and opened. At this time, the isolation unit 50 is linked to the partition wall 12 through the packing 51 and enters a state in which the bellows 52 expands and the lid 15 is stored inside the isolation chamber 17. Since there is almost no pressure differential inside the airtight container 11 and in the isolation chamber 17, there is no uneven air flow inside the airtight container 11 eliminating any concern that dust will enter into the inside of the airtight container 11 as well as any concern that the wafer W will move and be scratched. Next, a purge or an exhaust from the purge port 38 and the exhaust port 39 is implemented

so as to make the pressure of the isolation chamber 17 almost equal to the pressure of the transfer chamber 6.

[0045] When the pressure of the isolation chamber 17 and the transfer chamber 6 are almost equal and the X-axis cylinder 27 operates moving the cam roller 28 forward, isolation unit 50 will move rearward away from the partition wall 12 via the movable bench 24 due to the inclination of the cam groove 25 engaging with the cam roller 38. Further, as shown in Figure 8 (d), this allows a gap g to exist between the packing 51 of the isolation unit 50 and the partition wall 12.

[0046] Next, when the Z-axis cylinder 21 is driven and the cylinder rod 21a is drawn in, the elevator bench 22 is guided on the linear guide 20 and lowered and, as shown in Figure 8 (e), the entire isolation unit 50 and lid opening/closing mechanism 30 loaded on elevator bench 22 are stored inside the vertically long box 19 and the isolation unit 50 and lid opening/closing mechanism 30 are withdrawn from the linkage port 13.

[0047] Next, the transport arm 7 provided inside the transfer chamber 6 is extended, the wafer W inside the airtight container 11 is grasped from the linkage port 13, the wafer W is transported to the inside of the transfer chamber 6 and then delivered to a multi-chamber processing system through a predetermined process. When the processing of all the wafers W inside the airtight container 11 is complete, the open area 14 of the airtight container 11 is sealed by

the lid 15 and the operation to close the lid 15 will be performed as described above but in the reverse order.

[0048] Although the description in this embodiment describes a transport device that extracts wafers from an airtight container wherein semiconductor wafers are housed and then transports the wafers, the embodiment can also be applied to a device to transport an object to be processed such as an LCD substrate.

[0049] [Effect of the Invention]

According to present invention as described above, by means of matching the pressure inside an isolation chamber to the internal pressure of an airtight container before opening a lid of an airtight container that houses an object to be processed, when a lid is opened, the air will not enter into the inside of an airtight container nor will the air or gas inside an airtight container be emitted to the outside thereby making it possible to prevent uneven air flow. Therefore, dust that entered inside the airtight container does not adhere to the object to be processed making it possible to prevent the object to be processed from sliding and being scratched.

[Brief Description of the Drawings]

Figure 1 is a horizontal cross-sectional view of a transport device in a multi-chamber processing system wherein three vacuum processing chambers are arranged encircling the system in a first embodiment of the present invention;

Figure 2 is a side view of the embodiment of Figure 1;

Figure 3 is a front view of a lid opening/closing mechanism of the embodiment of Figure 1;

Figure 4 is a vertical cross-sectional side view of the lid opening/closing mechanism of the embodiment of Figure 1;

Figure 5 is a vertical cross-sectional side view of the lid opening/closing mechanism of the embodiment of Figure 1;

Figure 6 is a partial expanded front view of Figure 3,

Figure 7 is a descriptive operation view of the embodiment of Figure 1;

Figure 8 is a descriptive operation view of a second embodiment of the present invention.

[Description of Symbols]

6 Transfer chamber (room)

11 Airtight container

12 Partition wall

13 Linkage port

14 Open area

15 Lid

17 Isolation chamber

30 Lid opening/closing mechanism

Figure 1

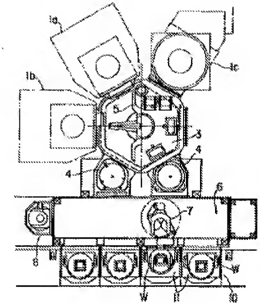

Figure 2

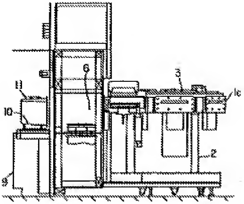

Figure 3

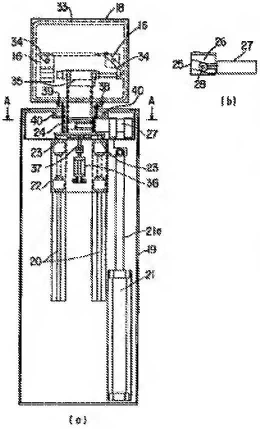

Figure 4 /7

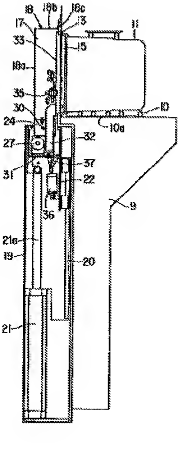

Figure 6

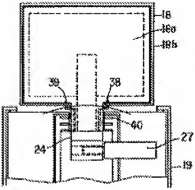

Figure 7

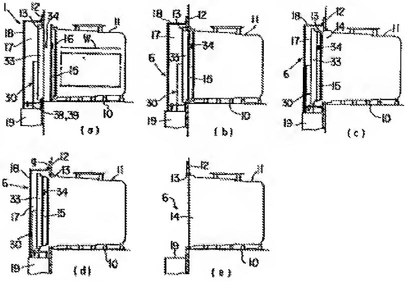

Figure 5

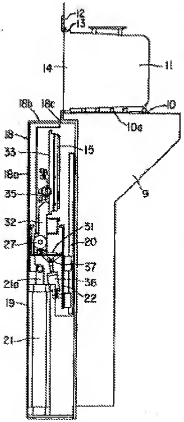

Figure 8 /8